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ABSORBENT ARTICLE FOR HYGIENIC FIBER PRODUCTS AND  
METHOD OF MANUFACTURING THE SAME

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The invention relates to an absorbent article for hygienic fiber products made of thermoplastic bonding fibers or mixtures of thermoplastic binders including cellulose fibers, cotton, cellulose fibers and/or plastic fibers in the form of individual pads or webs having different regions of density distributed over the cross section.

European Patent Document 01 69 184 discloses a fibrous absorptive article for use in disposable products such as diapers, feminine napkins or the like, which comprise absorbent fibers and a heat-activatable binder, preferably in the form of adhesive fibers. The absorbent article is characterized in that absorbent fibers and the binders form a homogenous

compound, and in that the density of the absorbent article gradually increases as "the result of a step-like increase in the degree of fiber bonding and compression in a direction perpendicular to its largest surface." The object of this type of arrangement is to achieve the highest fluid capacity and good fluid distribution within the absorbent article. Technological means which allow the afore-described absorbent article to be obtained, especially the described density distribution over the cross section, is that first a uniform mixture of absorbent fibers and binder fibers are deposited to form a pile, which is brought to the activation temperature of the binder fibers by heat. The web is subsequently cooled to a temperature just below the activation temperature of the binder. Then, in the second phase, the panel web is compressed with the help of rollers, one of which is cooled or at least has a temperature lower than the activation temperature of the binder, with the counter roller having a temperature that exceeds the activation temperature of the binder. This measure accomplishes that the bonding action in the direction of the hot roller to the cold roller decreases, and the web has the aforementioned degree of density after passing at least one pair of such rollers.

Further tests on heated, and subsequently compressed pile, have shown that another density distribution results in different and surprising

results especially if the absorbent body of the absorbent web is provided with three density regions in order to form an intergraded distribution layer, i.e., two other regions, with each having a density of 0.005-0.1 g/cm<sup>3</sup> and a middle region having a density of 0.05-0.3 g/cm<sup>3</sup>. A web or an absorbent article having this type of density distribution possesses excellent properties with respect to fluid absorption, fluid distribution, and fluid storage capacity if the web is made only slightly thinner, for example, on the order of one or several millimeters. The advantages, however, are not limited to thinner webs; rather, such webs or absorbent articles may be used advantageously when thicker webs are required with respect to the quantity of fluid that must be absorbed.

The two other density regions of the proposed absorbent article or the proposed absorbent webs should each occupy 10-40% of the entire thickness, and the middle density region 20-80% of the entire thickness of the absorbent article or web. The desired characteristics are especially apparent if the transition from one density region to the other is discontinuous rather than continuous as disclosed in known European Patent 01 69 184. In order to further improve these characteristics, the side of the absorbent article can be provided with a patterned impression on the side that contacts the body and as is known per se.

In order to manufacture the proposed absorbent article having the novel density distribution, a pile is first formed by the aerodynamic deposition of thermoplastic bonding fibers or mixtures of thermoplastic binders and cellulose fiber, cotton, cellulose flocks and/or plastic fibers. The pile is then heated to the activation temperature of the bonding agent or the bonding fibers and subsequently compressed.

In this case, the compression of the web or absorbent article is heated to the activation temperature occurs immediately, i.e., without intermediate cooling, with the help of two cold metal rollers, strips, or plates which form a pressure gap.

The absorbent article or web may be made completely of thermoplastic bonding fibers such as polyethylene fibers, polypropylene fibers or bi-component fibers of these two components. Bi-component fibers are also suitable whose components comprise polyester and whose other components comprise polyethylene or the like. It may also be advantageous not to make the entire absorbent article of these types of thermoplastic bonding fibers and to use mixtures of thermoplastic binders, such as of the aforementioned fibers with cellulose fiber, cotton, cellular flocks, and/or plastic fibers.

Plastic fibers are those made of non-thermoplastic materials, such as polyurethanes or duroplast. Fibers made of thermoplastic material may also be used whose softening temperature exceeds the softening temperature of the binder.

If these types of mixtures are used, the binders need not necessarily be in a fibrous form; binders in particle form may also be used, such as polyethylene, polypropylene, or polyester copolymers as well. If cellulose or cotton fiber mixtures are used, the length is preferably 10-40 mm, with a titer of 1.7-8 dtex.

If plastic fibers are used, they should be 20-100 mm in length, preferably, approximately 60 mm and a titer of 1.7-20 dtex, preferably, 3-4.

If bonding fibers alone or a mixture of cellulose fiber, cotton, cellular flocks and/or plastic fibers are used, they should have a length of 20-100 mm and a titer of 1.7-20 dtex.

A preferred method for making the proposed absorbent articles is characterized by the work steps below:

- the formation of a pile of  $150-500/\text{g/m}^2$  through the aerodynamic deposition of polyester PE-bi-component staple fibers having a length of 20-100 mm and a titer of 1.7 - 20 dtex;

- heating the pile by passing warm air having a temperature of 150°-250°C;

- compressing the warm pile to approximately one fourth of the original thickness by means of two cold metal rollers, strips, or plates.

Another embodiment of the method is characterized by the operational steps below:

- Manufacture of a mixture comprising 20-30 percent by weight of staple fibers made of cellulose fiber or cotton (length of fibers 10-40 mm; titer 1.7-8 dtex) or cellular flocks and 70-80 % by weight of polyester-PE-bi-component staple fibers having a length of 20-100 mm and a titer of 1.7 - 20 dtex;

- The formation of a pile 150-500 g/m<sup>2</sup> through the aerodynamic deposition of the aforementioned mixture;

- Heating the pile by passing hot air having a temperature of 150°C to 250°C through the same;

- Compressing the heated pile to approximately one fourth of the original thickness through a slot formed by two cold metal rollers, strips, or plates.

The compression tools used to implement the method are of special significance. As mentioned earlier, these tools comprise cold rollers, strips or plates made of metal. Two steel strips, which are cooled by air to room temperature are preferably used. The heat conductivity of the steel to be used ranges from 15-70 J/s x m x K, with J being the amount of heat in Joule, s the time in seconds, m the weight in kg, and K the temperature in Kelvin.

Embodiments of the inventive method is elucidated in greater detail below by way of examples:

#### EAXMPLE 1

A mixture comprising 25% cellulose (3.6 dtex; 30 mm fiber length) and 75% polyester-PP-bi-component fibers (3.3 dtex; 60 mm fiber length). The fiber mixture was opened over a carder and deposited in the form of a pile having the weight of 170 g/m<sup>2</sup> and a pile height of 30 mm. The pile was thermo fixed in an air circulation oven for 20 seconds at 150°C, with the thickness being reduced to approximately 13 mm. After discharge from the thermo fix assembly, the thermally compacted composite was subjected to compaction of the middle zone, and this was accomplished by the

compression of two steel plates having a smooth surface and cooled to room temperature. The time for the pressure treatment was 26 seconds. The resulting product was approximately 7 mm thick. It was subsequently laminated with a non-woven fabric and calibrated to a final thickness of 2 mm.

The liquid absorption capacity of the product obtained in this manner was determined to be in excess of 1.0 g per absorbent article. For purposes of comparison: without the compressed middle zone, the liquid absorption capacity of the article was less than 0.5 g.

The recovered elasticity was determined to be 94%. The air permeability was greater than  $20 \frac{1}{10} \text{ cm}^2 \times \text{min.}$  with a test pressure of 0.2 kpa.

## EXAMPLE 2

The method steps were the same as in Example 1. In place of the fiber mixture used there, a pile was used, which comprises up to 100% of hydrophilic bi-component fibers.

The obtained product had a fluid retention capacity greater than 2.0 g per absorbent article. The recovered elasticity of air permeability corresponds to the product obtained in accordance with Example 1.

## EXAMPLE 3



The method is also suitable for making feminine napkins. The same method steps as in Example 1 were used. The utilized fiber mixture corresponded to that of Example 1. Only difference being that the weight of the pile was  $450 \text{ g/m}^2$ . The end product had a thickness of 17 mm.

The measured values were:

The fluid retention capacity was approximately 110 g/ per absorbent article (120 x 120 mm).

### COMPARISON

The fluid retention capacity without compressed middle zone was approximately 34 g per absorbent article.

The invention is explained in greater detail below with reference to the drawings of which:

Fig. 1 is a perspective view of an embodiment of the thin inventive absorbent article;

Fig. 2 is an longitudinal view of the cut out section II-II.

Fig. 3 is a schematic view of the method steps.

Figure 1. The illustrated embodiment is a panty liner and is generally designated by reference numeral 1. The liners comprise a thin, approximately 2-mm-thick fiber composite, which is subjected to the

inventive middle zone compression. The usable surface 2 (in contact with the body) is provided with a non-woven layer 3 and shows on one side an embossed line pattern, and on the other side embossed dots 5. The dotted pattern extends over the entire surface 2; only a portion of the embossed dots are shown for the purpose of simplification.

Fig. 2 shows that the product comprises three zones of varying thickness, namely, two outer regions 6 and 7, with each being relatively thin, with the thickness being  $0.0005$  to  $0.1 \text{ g/cm}^3$ . The regions 6, 7 and 8, in this case, the transition from one density region to the other, is discontinuous, but due to intimate interlacing of the fibers, they form a coherent system in which the middle region 8 functions as an integrated distribution layer.

The laminated non-woven fiber layer 3 and the embossed line pattern are shown in the upper region of Fig. 2.

Fig. 3 is a schematic view of the manufacturing method for absorbent articles or webs. The assembly 10 serves to dissolve fibers and, if indicated, mixing the same. The starting fibers are fed into the system. The assembly is referred to as fiber processing unit.

The fibers from the fibers processing unit 10 reach the assembly 11, in which they are deposited aerodynamically as individual absorbent articles or an absorbent web. The assembly 11 is a carder.

After the absorbent articles or the web are deposited, they are transported for thermo fixing to the air circulation oven 12. From there, the product is transferred to the intermediate compression apparatus 13, which is illustrated symbolically by the air-cooled compression strips 14 and 14'.

The compressed product is subsequently covered with a non-woven fabric web 16, which is discharged from a supply roll 17. Both webs are then fed to the embossing calender 18 in which they are laminated on one side and embossed on the other side. The finished product leaves the system at 19 and can be rolled up, if a web is involved; but the web can also be split up, for example, into panty liners or the like.

#### Reference Numerals:

- 1     panty liner (absorbent article);
- 2     surface
- 3     non-woven fiber layer
- 4     linear embossed pattern
- 5     dotted embossed pattern
- 6;7   outer regions
- 8     middle regions
- 9     - -

- 10 fiber processing system
- 11 carding device
- 12 circulating air oven
- 13 intermediate compression
- 14; 14' compression strips
- 15 product
- 16 non-woven fiber web
- 17 reserve roller
- 18 embossing calander
- 19 finished Product.

## CLAIMS

1. Absorbent article for hygienic fiber products made of thermoplastic bonding fibers or mixtures of thermoplastic bonding agents including cellulose fibers, cotton, cellulose fibers and/or plastic fibers in the form of individual pads or webs having different regions of density distributed over the cross section, characterized in that said absorbent article (1) is provided with three compressed regions forming an integrated distribution layer having three zones of varying thickness, namely, two outer

regions 6 and 7, with each having a density of  $0.005-0.1 \text{ g/cm}^3$  and a middle region (8) having a density of  $0.05-0.3 \text{ g/cm}^3$ .

2. Absorbent article as defined in Claim 1, characterized in that the two other thickness regions (6; 7) each occupy 10 - 40% of the total thickness, and the middle density region (8) has a thickness of 20-80% of the total thickness of the absorbent article (1).

3. Absorbent article as defined in Claim 1 or 2 characterized in that in density regions (6, 7, 8) the transition is discontinuous.

4. Absorbent article as defined in Claim 1, 2 or 3, characterized in that during use, the surface of the absorbent article (1) that contacts the body is provided with an embossed pattern.

5. Method of manufacturing an absorbent article as defined in Claims 1 - 4, involving the aerodynamic deposition of thermoplastic bonding fibers or mixtures of thermoplastic binders and cellulose, cotton, cellulose flocks and/or plastic fibers, heating the pile to the activation temperature of the bonding agent or the bonding fibers and subsequently compressing the same, characterized in that the compression of the heated web or absorbent article, which is brought to the activation temperature of the binder, is accomplished directly, i.e., without any intermediate cooling, by two cold metal rollers, strips, or plates that form a compression gap.

6. Method as defined in Claim 5, characterized by the operating steps

below:

- forming of a pile of 150-500 g/m<sup>2</sup> through the aerodynamic deposition of polyester PE-bi-component staple fibers having a length of 20-100 mm and a titer of 1.7 - 20 dtex;
- heating the pile by passing hot air having a temperature of 150°- 250°C through the same;
- compressing the warm pile to approximately one fourth of the original thickness by means of two cold metal rollers, strips, or plates.

7. Method as defined in Claim 1, characterized by the operating steps

below:

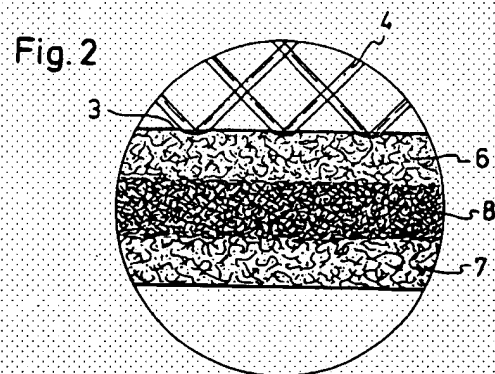
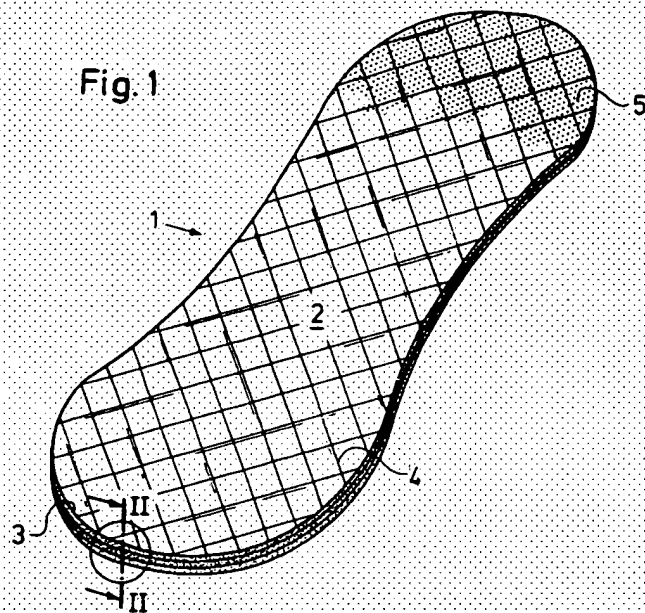
- manufacturing a mixture comprising 20-30 percent by weight of staple fibers made of cellulose fiber or cotton (length of fibers 10-40 mm; titer 1.7-8 dtex) or cellular flocks and 70-80 % by weight of polyester-PE-bi-component staple fibers having a length of 20-100 mm and a titer of 1.7 - 20 dtex;
- forming a pile 150-500 g/m<sup>2</sup> through the aerodynamic deposition of the aforementioned mixture;
- heating the pile by passing hot air having a temperature of 150°C to 250°C through the same;

- compressing the heated pile to approximately one fourth of the original thickness through a slot formed by two cold metal rollers, strips, or plates.

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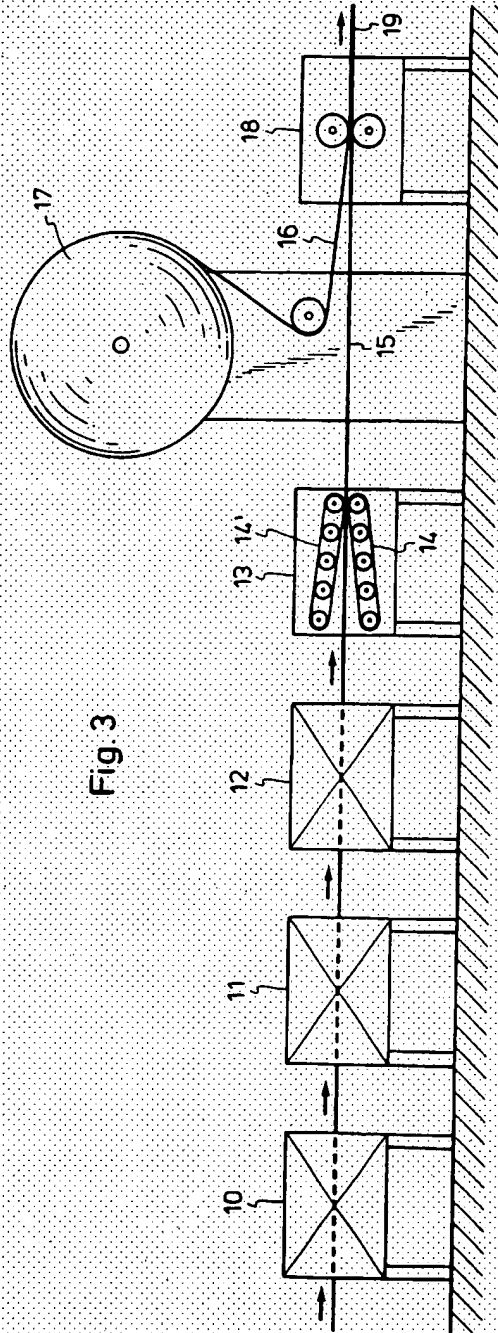


Fig. 3